

U.S. DEPARTMENT OF ENERGY  
FEDERAL ASSISTANCE PROGRAM/PROJECT STATUS REPORT

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1. Program/Project Identification No. DE-FC26-98FT40321	2. Program/Project Title JV Task 48 – Low-Temperature NO <sub>x</sub> Reduction Using High-Sodium Lignite-Derived Chars “CarbNO <sub>x</sub> ” Process	3. Reporting Period 4-1-02 through 6-30-02
4. Name and Address Energy & Environmental Research Center University of North Dakota PO Box 9018, Grand Forks, ND 58202-9018		5. Program/Project Start Date 4-15-98
		6. Completion Date 3-31-03

7. Approach Changes
<input type="checkbox"/> None

8. Performance Variances, Accomplishments, or Problems
The CarbNO <sub>x</sub> project was initiated during this quarter with a kickoff meeting for project sponsors held on May 22. The agenda included presentations on the background for and details of the project followed by a discussion of materials to be tested for char production. Project activities initiated during the quarter focused on procurement of coal samples, developing protocols for bench-scale char production and analysis, laboratory-scale testing of prepared char, and drafting a design for an NO <sub>x</sub> reduction reactor. A request for additional investment to complete the project funding package was granted by the Industrial Commission of North Dakota.
<input type="checkbox"/> None

9. Open Items
<input checked="" type="checkbox"/> None

10. Status Assessment and Forecast
Please see attachment.
<input type="checkbox"/> No Deviation from Plan is Expected

11. Description of Attachments
8. Performance Variances, Accomplishments, or Problems (continued) 10. Status Assessment and Forecast
<input type="checkbox"/> None

12. Signature of Recipient and Date	13. Signature of U.S. Department of Energy (DOE) Reviewing Representative and Date
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## **JV TASK 48 – LOW TEMPERATURE NO<sub>x</sub> REDUCTION USING HIGH-SODIUM LIGNITE-DERIVED CHARS “CarbNO<sub>x</sub>” PROCESS**

### **Quarterly Status Report**

**April 1 – June 30, 2002**

#### **8. Performance Variances, Accomplishments, or Problems (continued)**

##### **Selection and Procurement of Coal and Char Samples**

A detailed discussion with the project sponsors was the basis for the choice of the lignite coals and chars to be tested for the CarbNO<sub>x</sub> process. The coals include lignite samples currently being mined by BNI Coal from the Center Mine, Beulah–Zap from the Freedom Mine, and Luscar coal. All feedstock will be characterized chemically. Additionally, laboratory analysis and preliminary testing will be carried out on Luscar char. The procurement and analysis of these samples are currently under way.

##### **Char Synthesis**

Protocols have been developed for the synthesis of char from various coal samples. Initially, the procedures developed at the EERC and OSU will be carried out to synthesize char. These methods involve pyrolysis followed by an activation of the char by steam and/or CO<sub>2</sub>. Synthesis of char in one step by the direct pyrolysis and activation of lignite coal by simulated flue gas will also be attempted. Sample analyses will include physical and chemical properties of the solid products and characterization of the temporal evolution of the various gases that are produced from this one-step reaction. The use of a continuous IR analyzer and the analysis of batch gas samples by gas chromatography will quantify the nature and calorific content of the gases evolved in the char synthesis procedure. Analytical procedures for this laboratory characterization have been completed.

##### **Laboratory-Scale Testing of Chars for NO<sub>x</sub> Reduction at OSU**

The experimental setup at OSU is being modified for the simultaneous testing of multiple char samples for NO<sub>x</sub> reduction. The reactor has been designed, and the procurement of materials has begun. An electronic switching valve, purchased from VICI Inc. will allow the use of one set of gas analyzers to monitor multiple gas streams coming from multiple microreactors. The unit consists of a multiposition microelectronic valve actuator and a digital valve sequence programmer.

A multisorbent bed reactor is also being designed. The reactor is capable of sending identical inlet gas mixtures in terms of its total flow, gas concentrations, and temperature to each of the char samples. The implementation of this scheme will eliminate errors that could occur between various experiments.

## **Preliminary Testing of CarbNO<sub>x</sub> on the CEPS Unit**

Preliminary data acquisition for the feasibility of this process will be carried out on the offgases exiting a coal combustion unit – the conversion and environmental process simulator (CEPS). This process involves contacting hot ash-laden flue gas with carbonaceous materials. The initial design for this purpose is a spouting bed to avoid ash buildup and the concomitant plugging of the carbon bed. In a spouting bed, the velocity of the flue gases is high enough to suspend the char particles. The ash passes through the bed, and the movement of the char particles assures that no ash buildup can take place. Concurrently, we are also considering a variety of reactor designs that can adequately manage ash while avoiding carbon carryover from the NO<sub>x</sub> reactor.

## **Moving-Bed Reactor Design**

We are also designing a granular filtration system for the management of the ash. Granular filters in a moving-bed configuration have been used in the past, and related designs are proving to be a method of choice for hot-gas filtration required in integrated gasification combined cycle configurations. To this end, we have procured the hardware necessary for erecting a testing facility that would study the increase in pressure with rising ash buildup on a fixed bed of particles. The required expanders and Plexiglas sheets have been obtained as well.

## **10. Status Assessment and Forecast**

### **Char Synthesis**

Steam- and CO<sub>2</sub>-activated chars will be prepared in the continuous fluidized-bed reactor and a tube furnace under varying temperature and gas stream conditions. Both feedstock and activated products will be characterized as described in Section 8.

### **Laboratory-Scale Testing of Chars for NO<sub>x</sub> Reduction at OSU**

Prepared chars will undergo bench-scale testing to compare NO<sub>x</sub> reduction effectiveness and to optimize char production.

## **Preliminary Testing of CarbNO<sub>x</sub> on the CEPS Unit**

The spouting-bed reactor will be constructed and installed in the CEPS.